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Science's stagnant thinking: our rivers need a revolution

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Science's stagnant thinking: our rivers need a revolution

Abstract

I've been away in the UK for a few years - and what do I find when I come back? In the Murray Darling we are still arguing over inputs (the amount of water to be returned to the river) instead of focusing on the state we actually want the river system to be in, and how to make it so.

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Disclosure Statement

Before going to the UK four years ago I was chair of the Science Reference Group for the (then) Murray-Darling Basin Commission's "Living Murray" program, a member of the Commonwealth Dept of Environment Threatened Species Scientific Committee, and a member of the Aquatic Ecosystem Advisory Group, National Water Commission. Now I am back, and right now I have no funding, no consultancies, and no committee memberships other than membership of the steering committee of the Australian Academy of Technological Sciences and Engineering water forum.

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Given our neo-Platonic visions of universal ecologies, when it comes to restoring waterways we're up the proverbial creek without a paddle. Flickr/Annadriel

I've been away in the UK for a few years – and what do I find when I come back? In the Murray Darling we are still arguing over inputs (the amount of water to be returned to the river) instead of focusing on the state we actually want the river system to be in, and how to make it so.

We burn money trying to restore rivers

Water is no more than a means to an end, and if I have learned one thing it is that means don't guarantee ends in this game. Restoring the ecological condition of rivers is not easy: we rarely achieve large-scale ecological management and restoration. European Union member states have spent over €80 billion (A$102 billion) to little effect in an effort to return their rivers to "good" ecological condition, and statistical analyses of thousands of river and catchment restoration projects around the world indicate that success rates are low: one sometimes needs a stiff drink when reading about research into restoration projects, with only around 10% of such projects achieving documented success.

The European Environmental Bureau, a federation of 140 EU citizens groups, reviewed what had been achieved 10 years on from the EU's Water Framework Directive, which was aimed at cleaning and restoring waterways. The federation's report has an appropriately depressed tone: "massive procrastination"; "generic excuses"; "unnecessarily drowning in complexity and ignorance"; "lack of transparency and robust assessments", and so on.

So this is the elephant in the room: river restoration is rarely successful, so we talk about inputs instead: money invested, volumes of water diverted, meetings held, kilometres of fences built. Then we do a lot of hand waving about time lags - and hope.

No eyes on the prize: instead we get busy with getting busy. Maybe it's all we know how to do. Flickr/lightbrigade

We don't know what we're doing

You can get people to talk about this problem privately but not publicly. It is time for a more public debate. We have a major policy conundrum on our hands. Just now, when "evidence-based" policy is so popular, the lack of real success stories from ecological research is striking. More often than we care to face up to, we are flailing around with little idea of whether our actions work or not. As MJF Taylor and his peers found when they studied conservation efforts for threatened species in Australia, "there is surprisingly little evidence about which conservation approaches are effective in arresting or reversing threatened species declines." What was clear was that most species continued to decline.

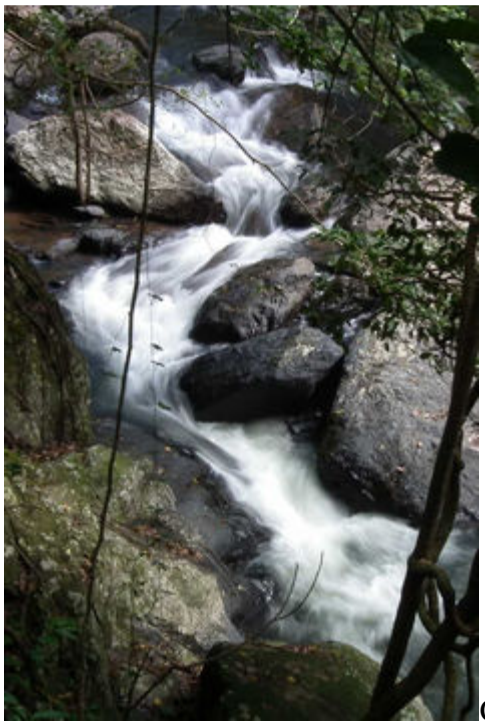
We do achieve many minor victories, but the big picture is not so good. Large-scale global assessments such as the Millennium Ecosystem Assessment and the 3rd Global Biodiversity Outlook show widespread declining biodiversity and ecosystem degradation, especially in freshwaters. We have achieved success with many individual species but at the community and ecosystem level (particularly at regional and catchment scales) we are failing.

Universal models do not apply

I have recently edited a special edition of Freshwater Biology dealing with these matters, but I am not the first to note this sorry state of affairs; this issue has been written about for decades. In 1999 John Lawton noted that "community ecology is a mess" and subsequent papers by others have spelt out time and again the problems with predicting how multi-species ecosystems will respond to management actions. Lawton concluded that "localism" - each place's complex cluster of variables and contingencies – was one of the main reasons for this lack of predictability.

Ecology seeks generalisation, universal laws and transportable models: managers like these too. The science assumes that averages from sparse data are meaningful, that models make useful predictions and, if we all keep doing what we are doing, "she'll be right" eventually. But that is not reality - in the real world contingent localism defies universality and it defies scientific approaches that assume universality.

In the 1990s Brian Wynne spoke of the pervasive institutional role of science in underplaying risk and defining away uncertainty. We have to face these fundamental uncertainties head on and not sweep them under the rug.


Change is constant; there is no equilibrium. Flickr/hotdipper

Change is constant, there is no equilibrium, and unpredictable extreme events are important. Everything is on a trajectory to somewhere, we can't go back, and much of what we are trying to manage is complex and ill-understood. Perverse outcomes are as likely as the desired ones. The evidence we have is not fit for the purpose we want to use it for: it is mostly collected at the wrong scales, or was collected for some other purpose and has been shoe-horned in later.

Do not trust predictive ecological models

Predictive ecological models are simply not to be trusted as the basis of management action. Predictions are flawed, measures are ineffective, money is spent to little effect. The recent UK Comptroller and Auditor General's report on the UK Environment Agency made this point, as have recent reports from the Australian National Audit Office (ANAO) on similar topics. An ANAO report on the Regional Delivery Model for the national Action plan for Salinity and Water Quality found that almost half of the "resource condition targets identified in the plans did not meet the stated criteria in terms of being measurable or having a specific timeframe". Writing about conservation programs that boast 800,000 volunteers across Australia, the ANAO laments that "the absence of consistently validated data, the lack of agreement on performance indicators and any intermediate outcomes has significantly limited the quality of the reporting process."

We lack good evidence and predictive power. The data we have are sparse and "noisy" and it takes heroic actions to achieve measurable results. Part of our problem – in addition to institutional issues – lies in some fundamental misconceptions in ecological theory: much of the uncertainty we face is probably irreducible with present knowledge. Rob Peters published a swingeing critique of ecology in 1991 . He highlighted the tautological nature of most ecological theory and the lack of predictive power. That book was ignored.

Lost in patterns: ecological theory is too often tautological. Flickr/jbrownell

Fundamental and unaddressed issues of science and public policy

If restoration efforts aren't working well enough it is not sufficient to pretend that we just keep doing what we are doing – it is time to drag the elephant out from under the rug and critically examine our underpinning ecological assumptions, concepts and methodologies. There is a growing literature which criticises "predict-act" frameworks when the situation is complex, value laden, and uncertain (which it certainly is). Jerry Ravetz made this same point as far back as the 1990s, too, while in 2005 Robert Hilderbrand and his peers did a marvellous dissection of the flawed thinking we too often bring to bear in our efforts to restore ecologies.

The fundamental question "can we achieve what we desire" goes to the heart of much modern "evidence based" natural resource management policy, and resource economics - be it payments for ecosystem services or whatever. However, our policies are out to sea, packed with convenient but mistaken assumptions and what philosophers call category errors - they are at massive risk of simply not working.

Solutions are beginning to appear in the shadows. We have access to new concepts and technologies in ecology. Advances in computing and statistical physics are providing new tools to help us understand both local complexity and uncertainty. With better data we can import recent advances in data mining and systems biology into ecology and natural resource management. In addition, new smart web-enabled sensors will provide new kinds of data for managers. Sending a couple of people out with a land cruiser, a tin dinghy and a bucket once every couple of weeks to monitor a river no longer suffices. Old infrastructure does not fix the new challenge of restoration.

Monitoring of inputs into rivers has at times been increased, but in recent years monitoring of what finally matters and matters most in ecological terms - water quality and environmental conditions - has been cut back in states including NSW, Victoria, and Tasmania. This is folly, for we need more data and better evidence of the results of environmental management actions, not less.

The blind leading the blind: without gathering the information of prime importance, how can we know what to do? Flickr/Squonk11

The past is no guide to the future

Rather than “going for broke” with ambitious goals unlikely to be realised via confused, contradictory, and illogical plans, incremental localised evidence about what is working and not working would transform our attempts at adaptive environmental management. We have been changing our environment for many centuries; we cannot go back to some previous ideal state or time. The past is no guide to the future.

We must find new ways to monitor, manage and achieve outcomes under uncertainty. Traditional approaches to evidence-based policy and “predict-act” environmental management nostrums are not working. Localism is the key to both the science and the community engagement. In the face of uncertainty we require what Mike Young calls robust reform: not just “muddling through” assuming average conditions, but responding in ways which work even under extreme challenge.

What we need is new thinking, eco-innovation, better evidence, and to keep our eye on the ecological prize - like a flourishing Murray-Darling - instead of forever indulging in sterile debates over who gets how much water and who doesn’t.